## DETAILED ACTION

1.      The Amendment received on January 30, 2008 has been entered into the record.

## EXAMINER'S AMENDMENT

2.      An examiner's amendment to the record appears below. Should the changes and/or

additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR

1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the

payment of the issue fee.

        Authorization for this examiner's amendment was given in a telephone interview with

Attorney Mary Olynick on February 25, 2008.   Specifically, **claims 2-4, 6, 20, 24, 44, and 45**

will be amended to overcome objections due to lack of antecedent basis and to correct any

grammatical errors.  **Claim 11** will be amended to remove the indefinite phrase that includes

'such as.'  See attached PTOL-413B.

        The Amended claims are:


        2.(Currently Amended)  A method as recited in claim 1, wherein the optical system is

configured to have an illumination and/or collection numerical aperture, NA, [[(NA)]] and/or

spectral band selected so that only a specific diffraction order is collected and measured for the

plurality of measured optical signals.


        3.(Currently Amended) A method as recited in claim 2, wherein the optical system is

configured to have an illumination and/or collection NA and/or spectral band selected so that

only a $0^{th}$ diffraction order is collected and measured for the plurality of measured optical signals

and wherein the illumination NA of the optical system equals the collection NA, an incident

beam of the optical system is normal to a surface of the sample, and the optical system is

configured to meet a̲ [[the]] following condition:

$$n\lambda=d(NA_i + NA_c)$$

wherein n equals 1, $\lambda$ is a̲ [[the]] wavelength, d is a pitch of a̲ [[the]] target's structures,

$NA_i$ is the illumination numerical aperture, and $NA_c$ is the collection numerical aperture.

4.(Currently Amended)  A method as recited in claim 2, wherein the illumination NA of

the optical system equals the collection NA, and incident beam of the optical system is normal to

a surface of the sample, and the optical system is configured to meet a̲ [[the]] following

condition:

$$n\lambda \geq 2dNA(1 + \varepsilon)$$

wherein n equals 1, $\lambda$ is a̲ [[the]] wavelength, d is a pitch of a̲ [[the]] target's structures,

NA is the numerical aperture of the optical system, and $\varepsilon$ is an approximation factor for

structures of the periodic targets which are not infinitely periodic.

6.(Currently Amended) A method as recited in claim 2, wherein the spectral band of the optical system is selected by adjusting a wavelength selection device or a [[the]] wavelength modulation device.

11.(Currently Amended) A method as recited in claim 2, wherein the analysis of the measured optical signals includes deriving spectral information from the measured optical signals using a transform, ~~such as a Fourier or a Hadamard transform~~.

20.(Currently Amended) A method for determining an overlay error between at least two layers in a multiple layer sample, the method comprising:

(a) using an optical system to measure a plurality of measured optical signals from a plurality of periodic targets on the sample, wherein the targets each have a first structure in a first layer and a second structure in a second layer, wherein there are predefined offsets between the first and second structures; and

(b) using a scatterometry overlay technique to analyze the measured optical signals of the periodic targets and the predefined offsets of the first and second structures of the periodic targets to thereby determine and store an overlay error between the first and second structures of the periodic targets, wherein the scatterometry overlay technique is a phase based technique that includes representing each of the measured optical signals as a set of periodic functions having a plurality of known parameters and an unknown overlay error parameter and analyzing the set of

periodic functions to solve for the unknown overlay error parameter to thereby determine the

overlay error, ~~errors,~~

wherein the optical system has a broadband source for generating an optical incident

beam having multiple wavelengths, a detector for detecting a measured signal from the sample in

response to the incident beam and a filter for selectively passing particular one or more

wavelengths of the output signal to the detector, wherein using the optical system includes

directing at least one radiation beam towards each target to measure a plurality of measured

signals from the periodic targets while adjusting the filter so as to pass a particular one or more

wavelengths of the measured signals through the filter towards the detector in the form of a

plurality of filtered signals, and

wherein the analysis of the filtered signals and the predefined offsets includes including

an intensity from some or all of the pixels of an image of each target and combining the

intensities of each target together to give an intensity value for each target at a particular setting

of the filter.

24.(Currently Amended) A method for determining an overlay error between at least two

layers in a multiple layer sample, the method comprising:

(a) using an optical system to measure a plurality of measured optical signals from a

plurality of periodic targets on the sample, wherein the targets each have a first structure in a first

layer and a second structure in a second layer, wherein there are predefined offsets between the first and second structures; and

(b) using a scatterometry overlay technique to analyze the measured optical signals of the periodic targets and the predefined offsets of the first and second structures of the periodic targets to thereby determine and store an overlay error between the first and second structures of the periodic targets, wherein the scatterometry overlay technique is a phase based technique that includes representing each of the measured optical signals as a set of periodic functions having a plurality of known parameters and an unknown overlay error parameter and analyzing the set of periodic functions to solve for the unknown overlay error parameter to thereby determine the overlay error, ~~errors,~~

wherein the optical system has a broadband source for generating an optical incident beam having multiple wavelengths, a detector for detecting a measured signal from the sample in response to the incident beam and a filter for selectively passing particular one or more wavelengths of the output signal to the detector, wherein using the optical system includes directing at least one radiation beam towards each target to measure a plurality of measured signals from the periodic targets while adjusting the filter so as to pass a particular one or more wavelengths of the measured signals through the filter towards the detector in the form of a plurality of filtered signals, and

repeating operation (a) over multiple wavelengths, wherein the measured optical signals

having the largest contrast are used to determine overlay error.


44.(Currently Amended) A method as recited in claim 43, wherein the predefined offsets

can be represented as Xa, Xb, Xc, and Xd so as to meet a [[the]] following condition:


Xa-Xc=Xc-Xb=Xb-Xd=Xd-Xa+P=P/4, wherein P is a pitch of each of the four periodic

targets.


45.(Currently Amended) A method as recited in claim 1, wherein the predefined offsets

include a +/-F constant and a +/-f0 constant, wherein the +/- F constant equals 1/4 of a pitch of

the periodic targets and f0 constant is outside a region of interest for the determined overlay error

and does not cause the uncertainty of the determined overlay error to allow an out-of-

specification overlay error to be determined as an in-specification overlay error.


### *Allowable Subject Matter*

3.    **Claims 1-16, 19, 20, 22-30, 38-40, 43-45** are allowed.

The following is an examiner's statement of reasons for allowance:

As to **claim 1**, the prior art of record, taken alone or in combination, fails to disclose or

render obvious in a method of determining an overlay error the particular phase based technique,

in combination with the rest of the limitations of **claims 1-16, 19, 25, 29, 30, 38-40, and 43-45.**

As **to claim 20,** the prior art of record, taken alone or in combination, fails to disclose or render obvious in a method for determining an overlay error the particular obtaining an intensity and combining steps, in combination with the rest of the limitations of **claims 20, 22-23, 26-28.**

As **to claim 24,** the prior art of record, taken alone or in combination, fails to disclose or render obvious in a method for determining an overlay error having the largest contrast being used to determine overlay error, in combination with the rest of the limitations of **claim 24.**

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### *Conclusion*

4.     The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

| | |
|---|---|
| U.S. Patent 4,710,642 to McNeil | U.S. Patent 7,061,623 to Davidson |
| US 2006/0050283 to Hill | U.S. Patent 7,193,715 to Smedt et al. |
| U.S. Patent 7,242,477 to Mieher et al. | U.S. Patent 7,280,230 to Shchegrov et al. |

U.S. Patents 7,280,212; 7,289,213; 7,298,481; 7,301,634; and 7,317,531 to Mieher et al.

### *Fax/Telephone Numbers*

If the applicant wishes to send a fax dealing with either a proposed amendment or a discussion with a phone interview, then the fax should:

1) Contain either a statement "DRAFT" or "PROPOSED AMENDMENT" on the fax cover sheet; and

2) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as

quickly as possible.

*Papers related to the application may be submitted to Group 2800 by Fax transmission.*
*Papers should be faxed to Group 2800 via the PTO Fax machine located in Crystal Plaza 4. The*
*form of such papers must conform to the notice published in the Official Gazette, 1096 OG 30*
*(November 15, 1989). The CP4 Fax Machine number is:* **(571) 273-8300**

Any inquiry concerning this communication or earlier communications from the examiner

should be directed to Gordon J. Stock whose telephone number is (571) 272-2431.

The examiner can normally be reached on Monday-Friday, 8:00 a.m. - 6:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Gregory J. Toatley, Jr., can be reached at 571-272-2800 ext 77.

Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private Pair

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


/G. J. S./
GJS
Examiner, Art Unit 2877

/Gregory J. Toatley, Jr./
Supervisory Patent Examiner, Art Unit 2877